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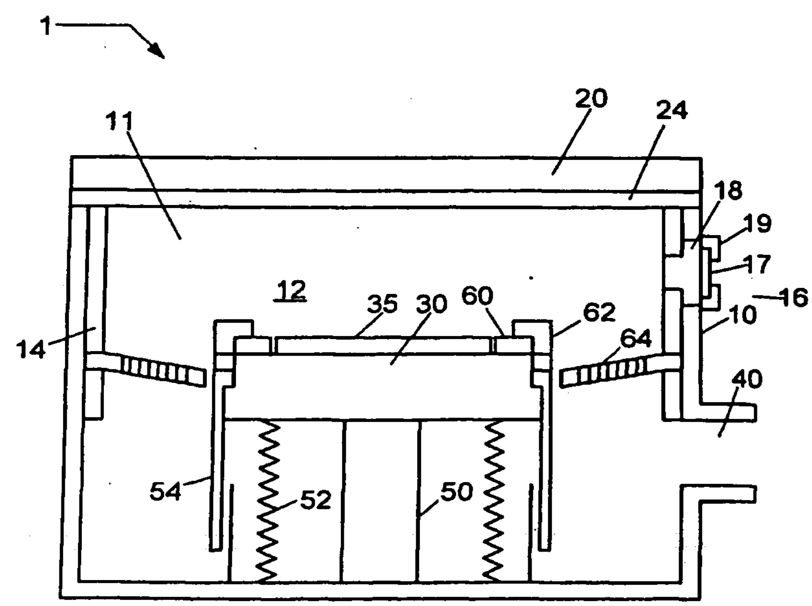
(54) Title: METHOD AND APPARATUS FOR AN IMPROVED DEPOSITION SHIELD IN A PLASMA PROCESSING SYSTEM



(57) Abstract: The present invention presents an improved deposition shield for surrounding a process space in a plasma processing system, wherein the desing and fabrication of the deposition shield advantageously provides for a clean processing plasma in the process space with substantially minimal erosion of the deposition shield.

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METHOD AND APPARATUS FOR AN IMPROVED DEPOSITION SHIELD IN A PLASMA PROCESSING SYSTEM

Cross-reference to Related Applications

[0001] This application is related to co-pending United States patent application serial no. 10/XXX,XXX, entitled "Method and apparatus for an improved upper electrode plate with deposition shield in a plasma processing system", Attorney docket no. 226272US6YA, filed on even date herewith; co-pending United States patent application serial no. 10/XXX,XXX, entitled "Method and apparatus for an improved baffle plate in a plasma processing system", Attorney docket no. 226274US6YA, filed on even date herewith; co-pending United States patent application serial no. 10/XXX,XXX, entitled "Method and apparatus for an improved baffle plate in a plasma processing system", Attorney docket no. 228411US6YA, filed on even date herewith; co-pending United States patent application serial no. 10/XXX,XXX, entitled "Method and apparatus for an improved upper electrode plate in a plasma processing system", Attorney docket no. 225277US6YA, filed on even date herewith; co-pending United States patent application serial no. 10/XXX,XXX, entitled "Method and apparatus for an improved optical window deposition shield in a plasma processing system", Attorney docket no. 226276US6YA, filed on even date herewith; and co-pending United States patent application serial no. 10/XXX,XXX, entitled "Method and apparatus for an improved bellows shield in a plasma processing system", Attorney docket no. 226277US6YA, filed on even date herewith. The entire contents of all of those applications are herein incorporated by reference in their entirety.

Field of the Invention

[0002] The present invention relates to an improved component for a plasma processing system and, more particularly, to a deposition shield employed in a plasma processing system for protecting a chamber wall.

Background of the Invention

[0003] The fabrication of integrated circuits (IC) in the semiconductor industry typically employs plasma to create and assist surface chemistry within a plasma reactor necessary to remove material from and deposit material to a substrate. In general, plasma is formed within the plasma reactor under vacuum conditions by heating electrons to energies sufficient to sustain ionizing collisions with a supplied process gas. Moreover, the heated electrons can have energy sufficient to sustain dissociative collisions and, therefore, a specific set of gases under predetermined conditions (e.g., chamber pressure, gas flow rate, etc.) are chosen to produce a population of charged species and chemically reactive species suitable to the particular process being performed within the chamber (e.g., etching processes where materials are removed from the substrate or deposition processes where materials are added to the substrate).

[0004] Although the formation of a population of charged species (ions, etc.) and chemically reactive species is necessary for performing the function of the plasma processing system (i.e. material etch, material deposition, etc.) at the substrate surface, other component surfaces on the interior of the processing chamber are exposed to the physically and chemically active plasma and, in time, can erode. The erosion of exposed components in the plasma processing system can lead to a gradual degradation of the plasma processing performance and ultimately to complete failure of the system.

[0005] In order to minimize the damage sustained by exposure to the processing plasma, components of the plasma processing system, known to sustain exposure to the processing plasma, are coated with a protective barrier. For example, components fabricated from aluminum can be anodized to produce a surface layer of aluminum oxide, which is more resistant to the plasma. In another example, a consumable or replaceable component, such as one fabricated from silicon, quartz, alumina, carbon, or silicon carbide, can be inserted within the processing chamber to protect the surfaces of more valuable components that would impose greater costs during frequent replacement. Furthermore, it is desirable to select surface materials that minimize the introduction of unwanted contaminants, impurities, etc. to the processing plasma and possibly to the devices formed on the substrate.

[0006] In both cases, the inevitable failure of the protective coating, either due to the integrity of the protective barrier or the integrity of the fabrication of the protective barrier, and the consumable nature of the replaceable components demands frequent maintenance of the plasma processing system. This frequent maintenance can produce costs associated with plasma processing down-time and new plasma processing chamber components, which can be excessive.

Summary of the Invention

[0007] The present invention provides an improved deposition shield for surrounding a process space in a plasma processing system, wherein the design and fabrication of the deposition shield advantageously addresses the above-identified shortcomings.

[0008] It is an object of the present invention to provide a deposition shield that can be coupled to the plasma processing system comprising a cylinder having an inner surface, an outer surface, an upper end surface, and a lower end surface. The lower end surface can further comprise an end lip surface.

[0009] It is another object of the present invention to further provide a deposition shield comprising a plurality of fastening receptors, each coupled to the upper end surface and the lower end surface of the deposition shield and configured to attach the deposition shield to the plasma processing system.

[0010] It is another object of the present invention to further provide a deposition shield comprising an opening for enabling access to the process space through the deposition shield. The opening can comprise a first opening surface, a second opening surface, and a mating surface, wherein the mating surface can comprise one or more tapped holes comprising a fastening surface.

[0011] It is another object of the present invention that the deposition shield further comprises a protective barrier formed on a plurality of exposed surfaces of the deposition shield facing the processing plasma.

[0012] It is a further object of the present invention that the exposed surfaces of the deposition shield comprise the inner surface of the deposition shield, the upper end surface of the deposition shield, and the end lip surface of the lower end surface of the deposition shield.

[0013] It is a further object of the present invention that the deposition shield can comprise additional exposed surfaces such as the first opening surface of the opening, and the mating surface excluding the fastening surface of the opening in the deposition shield.

[0014] The present invention further provides a method of producing the deposition shield in the plasma processing system comprising the steps: fabricating the deposition shield; anodizing the deposition shield to form a surface anodization layer on the deposition shield; machining exposed surfaces on the deposition shield to remove the surface anodization layer; and forming a protective barrier on the exposed surfaces of the deposition shield.

[0015] The present invention provides another method of producing the deposition shield in the plasma processing system comprising the steps: fabricating the deposition shield; masking the exposed surfaces on the deposition shield to prevent formation of a surface anodization layer; anodizing the deposition shield to form the surface anodization layer on the deposition shield; and forming a protective barrier on the exposed surfaces of the deposition shield.

[0016] The present invention provides another method of producing the deposition shield in the plasma processing system comprising the steps: fabricating the deposition shield; and forming a protective barrier on the exposed surfaces of the deposition shield.

[0017] The present invention may optionally include machining other parts not actually exposed to the plasma. Such parts may be machined in order to provide a contact free from the anodization layer (e.g., in order to provide a better mechanical or electrical contact).

[0018] The present invention may optionally include masking of other parts not actually exposed to the plasma. Such parts may be masked in order to provide a contact free from the anodization layer (e.g., in order to provide a better mechanical or electrical contact).

[0019] The present invention also provides a combined method of machining and masking to provide bare exposed surfaces on which to form the protective barrier.

Brief Description of the Drawings

[0020] These and other advantages of the invention will become more apparent and more readily appreciated from the following detailed description of the exemplary embodiments of the invention taken in conjunction with the accompanying drawings, where:

[0021] FIG. 1 shows a simplified block diagram of a plasma processing system comprising a deposition shield according to an embodiment of the present invention;

[0022] FIG. 2 shows a plan view of a deposition shield for a plasma processing system according to an embodiment of the present invention;

[0023] FIG. 3 shows a partial cross sectional view of a deposition shield for a plasma processing system according to an embodiment of the present invention;

[0024] FIG. 4 shows an expanded cross sectional view of a deposition shield for a plasma processing system according to an embodiment of the present invention;

[0025] FIG. 5 shows an expanded view of a lower end surface of a deposition shield for a plasma processing system according to an embodiment of the present invention;

[0026] FIG. 6 presents an expanded view of an opening in a deposition shield for a plasma processing system according to an embodiment of the present invention;

[0027] FIG. 7 presents an expanded cross sectional view of an opening taken along a major axis of the opening for a plasma processing system according to an embodiment of the present invention;

[0028] FIG. 8 shows a cross sectional view of a mating surface and a fastening surface of an opening for a plasma processing system according to another embodiment of the present invention;

[0029] FIG. 9 presents a method of producing a deposition shield for a plasma processing system according to an embodiment of the present invention;

[0030] FIG. 10 presents a method of producing a deposition shield for a plasma processing system according to another embodiment of the present invention; and

[0031] FIG. 11 presents a method of producing a deposition shield for a plasma processing system according to another embodiment of the present invention.

Detailed Description of an Embodiment

[0032] According to an embodiment of the present invention, a plasma processing system 1 is depicted in FIG. 1 comprising a plasma processing chamber 10, an

upper assembly 20, an electrode plate 24, a substrate holder 30 for supporting a substrate 35, and a pumping duct 40 coupled to a vacuum pump (not shown) for providing a reduced pressure atmosphere 11 in plasma processing chamber 10. Plasma processing chamber 10 can facilitate the formation of a processing plasma in a process space 12 adjacent substrate 35. The plasma processing system 1 can be configured to process 200 mm substrates, 300 mm substrates, or larger.

[0033] In the illustrated embodiment, upper assembly 20 can comprise at least one of a cover, a gas injection assembly, and an upper electrode impedance match network. For example, the electrode plate 24 can be coupled to an RF source. In another alternate embodiment, the upper assembly 20 comprises a cover and an electrode plate 24, wherein the electrode plate 24 is maintained at an electrical potential equivalent to that of the plasma processing chamber 10. For example, the plasma processing chamber 10, the upper assembly 20, and the electrode plate 24 can be electrically connected to ground potential.

[0034] Plasma processing chamber 10 can, for example, further comprise a deposition shield 14 for protecting the plasma processing chamber 10 from the processing plasma in the process space 12, and an optical viewport 16. Optical viewport 16 can comprise an optical window 17 coupled to the backside of an optical window deposition shield 18, and an optical window flange 19 can be configured to couple optical window 17 to the optical window deposition shield 18. Sealing members, such as O-rings, can be provided between the optical window flange 19 and the optical window 17, between the optical window 17 and the optical window deposition shield 18, and between the optical window deposition shield 18 and the plasma processing chamber 10. Optical viewport 16 can, for example, permit monitoring of optical emission from the processing plasma in process space 12.

[0035] Substrate holder 30 can, for example, further comprise a vertical translational device 50 surrounded by a bellows 52 coupled to the substrate holder 30 and the plasma processing chamber 10, and configured to seal the vertical translational device 50 from the reduced pressure atmosphere 11 in plasma processing chamber 10. Additionally, a bellows shield 54 can, for example, be coupled to the substrate holder 30 and configured to protect the bellows 52 from the processing plasma. Substrate holder 10 can, for example, further be coupled to at least one of a focus ring 60, and a shield ring 62. Furthermore, a baffle plate 64 can extend about a periphery of the substrate holder 30.

[0036] Substrate 35 can be, for example, transferred into and out of plasma processing chamber 10 through a slot valve (not shown) and chamber feed-through (not shown) via robotic substrate transfer system where it is received by substrate lift pins (not shown) housed within substrate holder 30 and mechanically translated by devices housed therein. Once substrate 35 is received from substrate transfer system, it is lowered to an upper surface of substrate holder 30.

[0037] Substrate 35 can be, for example, affixed to the substrate holder 30 via an electrostatic clamping system. Furthermore, substrate holder 30 can, for example, further include a cooling system including a re-circulating coolant flow that receives heat from substrate holder 30 and transfers heat to a heat exchanger system (not shown), or when heating, transfers heat from the heat exchanger system. Moreover, gas can, for example, be delivered to the back-side of substrate 35 via a backside gas system to improve the gas-gap thermal conductance between substrate 35 and substrate holder 30. Such a system can be utilized when temperature control of the substrate is required at elevated or reduced temperatures. In other embodiments, heating elements, such as resistive heating elements, or thermo-electric heaters/coolers can be included.

[0038] In the illustrated embodiment, shown in FIG. 1, substrate holder 30 can comprise an electrode through which RF power is coupled to the processing plasma in process space 12. For example, substrate holder 30 can be electrically biased at a RF voltage via the transmission of RF power from a RF generator (not shown) through an impedance match network (not shown) to substrate holder 30. The RF bias can serve to heat electrons to form and maintain plasma. In this configuration, the system can operate as a reactive ion etch (RIE) reactor, wherein the chamber and upper gas injection electrode serve as ground surfaces. A typical frequency for the RF bias can range from 1 MHz to 100 MHz and is preferably 13.56 MHz. RF systems for plasma processing are well known to those skilled in the art.

[0039] Alternately, the processing plasma formed in process space 12 can be formed using a parallel-plate, capacitively coupled plasma (CCP) source, an inductively coupled plasma (ICP) source, any combination thereof, and with and without DC magnet systems. Alternately, the processing plasma in process space 12 can be formed using electron cyclotron resonance (ECR). In yet another embodiment, the processing plasma in process space 12 is formed from the

launching of a Helicon wave. In yet another embodiment, the processing plasma in process space 12 is formed from a propagating surface wave.

[0040] Referring now to an illustrated embodiment of the present invention depicted in FIGs. 2 (plan view) and 3 (partial cross sectional view), deposition shield 14 can comprise a cylinder having an inner surface 82, an outer surface 84, an upper end surface 86, and a lower end surface 88. Furthermore, for example, a thickness of the deposition shield 14, dictated by the distance from the inner surface 82 to the outer surface 84 of the deposition shield 14, can range from 1 to 50 mm. Desirably, the thickness can range from 5 to 20 mm, and, preferably, the thickness is at least 10 mm.

[0041] Deposition shield 14 can, for example, further comprise a plurality of fastening receptors 100, each fastening receptor 100 coupled to the upper end surface 86 and the lower end surface 88, and configured to receive fastening devices (such as bolts) (not shown) to couple deposition shield 14 to plasma processing system 1. FIG 4 shows an expanded cross sectional view of deposition shield 14 and one of the plurality of fastening receptors 100. The fastening receptors 100 can comprise an entrant region 102, an entrant cavity 104, an exit through-hole 106, and an interior fastener surface 108. Furthermore, the interior fastener surface 108 can, for example, comprise a first entrant surface 110, a first lip surface 112, a second entrant surface 114, a second lip surface 116, and an exit surface 118. For example, the number of fastening receptors 100 formed within deposition shield 14 can range from 0 to 100. Desirably, the number of fastening receptors 100 can range from 5 to 20; and, preferably, the number of fastening receptors 100 is at least 8.

[0042] Additionally, deposition shield 14 can, for example, comprise one or more tapped receptor holes 119 configured to receive a fastening device (such as a bolt) (not shown) and configured to couple deposition shield 14 with a component of the plasma processing chamber 10 such as the upper assembly 20. For example, the number of tapped receptor holes 119 formed within deposition shield 14 can range from 0 to 20. Desirably, the number of tapped receptor holes 119 can range from 1 to 10; and, preferably, the number of tapped receptor holes 119 is at least 2.

[0043] FIG. 5 provides an expanded view of the lower end surface 88 of the deposition shield 14, wherein the lower end surface 88 further comprises an end lip surface 120 as shown.

[0044] Referring again to FIG. 1, deposition shield 14 can, for example, further comprise an opening 130 in order to accommodate access to the process space 12 through deposition shield 14. In an embodiment of the present invention, the opening 130 is not formed in deposition shield 14. In an alternate embodiment, the opening 130 is formed in deposition shield 14 to accommodate the insertion of at least one of a deposition shield plug (not shown) or an optical window deposition shield such as the one depicted in FIG. 1. For further details, co-pending United States patent application serial no. 10/XXX,XXX, entitled "Method and apparatus for an improved optical window deposition shield in a plasma processing system", Attorney docket no. 226276US6YA, filed on even date herewith, is incorporated herein by reference in its entirety.

[0045] In FIGs. 6 and 7, an expanded view of opening 130 in deposition shield 14 and a cross sectional view of opening 130, taken along a major axis of opening 130, respectively, are presented. As depicted in FIG. 7, opening 130 can further comprise a first opening surface 132 coupled to the inner surface 82 of the deposition shield 14, a second opening surface 134 coupled to the outer surface 84 of the deposition shield 14, and a mating surface 136 coupled to the first opening surface 132 and to the second opening surface 134. In addition, the mating surface 136 can comprise at least one tapped hole 138 for receiving a threaded fastener (not shown) in order to couple at least one of the chamber plug (not shown) or the optical window deposition shield (not shown) to the deposition shield 14. As shown in FIG. 8, the mating surface 136 further comprises a fastening surface 140 immediately adjacent to and extending within the tapped hole 138. Furthermore, for example, a width (along a major axis) of the opening 130 can range from 1 to 100 mm. Desirably, the width can range from 10 to 40 mm, and, preferably, the width is at least 25 mm. Furthermore, for example, a height (along a minor axis) of the opening 130 can range from 1 to 100 mm. Desirably, the height can range from 10 to 40 mm, and, preferably, the height is at least 15 mm.

[0046] Referring now to FIGs. 2 through 8, the deposition shield 14 further comprises a protective barrier 150 formed on a plurality of exposed surfaces 145 of the deposition shield 14. In an embodiment of the present invention, the exposed surfaces 145 can comprise the inner surface 82 of deposition shield 14, the upper end surface 86 of deposition shield 14, and the end lip surface 120 of the lower end surface 88 of deposition shield 14. Alternately, the exposed surfaces can further

comprise the first opening surface 132 of opening 130, and the mating surface 136 excluding the fastening surface 140 of opening 130.

[0047] In an embodiment of the present invention, the protective barrier 150 can comprise a compound including an oxide of aluminum such as Al_2O_3. In another embodiment of the present invention, the protective barrier 150 can comprise a mixture of Al_2O_3 and Y_2O_3. In another embodiment of the present invention, the protective barrier 150 can comprise at least one of a III-column element (column III of periodic table) and a Lanthanon element. In another embodiment of the present invention, the III-column element can comprise at least one of Yttrium, Scandium, and Lanthanum. In another embodiment of the present invention, the Lanthanon element can comprise at least one of Cerium, Dysprosium, and Europium. In another embodiment of the present invention, the compound forming protective barrier 150 can comprise at least one of Yttria (Y_2O_3), Sc_2O_3, Sc_2F_3, YF_3, La_2O_3, CeO_2, Eu_2O_3, and DyO_3.

[0048] In an embodiment of the present invention, the protective barrier 150 formed on deposition shield 14 comprises a minimum thickness, wherein the minimum thickness can be specified as constant across at least one of the exposed surfaces 145. In another embodiment, the minimum thickness can be variable across the exposed surfaces 145. Alternately, the minimum thickness can be constant over a first portion of an exposed surface and variable over a second portion of an exposed surface. For example, a variable thickness can occur on a curved surface, on a corner, or in a hole. For example, the minimum thickness can range from 0.5 micron to 500 micron. Desirably, the minimum thickness can range from 100 micron to 200 micron, and, preferably, the minimum thickness is at least 120 micron.

[0049] FIG. 9 presents a method of producing the deposition shield in the plasma processing system described in FIG. 1 according to an embodiment of the present invention. A flow diagram 300 begins in 310 with fabricating the deposition shield 14 (as described above). Fabricating the deposition shield can comprise at least one of machining, casting, polishing, forging, and grinding. For example, each of the elements described above can be machined according to specifications set forth on a mechanical drawing, using conventional techniques including a mill, a lathe, etc. The techniques for machining a component using, for example, a mill or a lathe, are well known to those skilled in the art of machining. The deposition shield can, for example, be fabricated from aluminum.

[0050] In 320, the deposition shield is anodized to form a surface anodization layer. For example, when fabricating the deposition shield from aluminum, the surface anodization layer can comprise aluminum oxide (Al_2O_3). Methods of anodizing aluminum components are well known to those skilled in the art of surface anodization.

[0051] In 330, the surface anodization layer is removed from the exposed surfaces 145 using standard machining techniques. In an embodiment of the present invention, the exposed surfaces comprise the inner surface of the deposition shield, the upper end surface of the deposition shield, and the end lip surface of the lower end surface of the deposition shield. Alternately, the exposed surfaces can further comprise the first opening surface of the opening, and the mating surface excluding the fastening surface of the opening in the deposition shield. In this step, or in a separate step, additional non-exposed surfaces may also be machined. Such non-exposed surfaces may be machined in order to provide better mechanical or electrical contacts between those parts and the parts with which they are mated.

[0052] In 340, a protective barrier is formed on the exposed surfaces 145. A protective barrier comprising, for example Yttria, can be formed using (thermal) spray coating techniques that are well known to those skilled in the art of ceramic spray coatings. In an alternate embodiment, forming the protective barrier can further comprise polishing (or smoothing) the thermal spray coating. For example, polishing the thermal spray coating can comprise the application of sand paper to the sprayed surfaces.

[0053] FIG. 10 presents a method of producing the deposition shield in the plasma processing system described in FIG. 1 according to another embodiment of the present invention. A flow diagram 400 begins in 410 with fabricating the deposition shield 14 (as described above). Fabricating the deposition shield can comprise at least one of machining, casting, polishing, forging, and grinding. For example, each of the elements described above can be machined according to specifications set forth on a mechanical drawing, using conventional techniques including a mill, a lathe, etc. The techniques for machining a component using, for example, a mill or a lathe, are well known to those skilled in the art of machining. The deposition shield can, for example, be fabricated from aluminum.

[0054] In 420, exposed surfaces are masked to prevent the formation of a surface anodization layer thereon. In this step, or in a separate step, additional non-exposed

surfaces may be masked. Such non-exposed surfaces may be masked in order to provide better mechanical or electrical contacts between those parts and the parts with which they are mated. Techniques for surface masking and unmasking are well known to those skilled in the art of surface coatings and surface anodization.

[0055] In 430, the deposition shield is anodized to form a surface anodization layer on the remaining unmasked surfaces. For example, when fabricating the deposition shield from aluminum, the surface anodization layer can comprise aluminum oxide (Al_2O_3). Methods of anodizing aluminum components are well known to those skilled in the art of surface anodization.

[0056] In 440, a protective barrier 150 is formed on the exposed surfaces 145. A protective barrier comprising, for example Yttria, can be formed using (thermal) spray coating techniques that are well known to those skilled in the art of ceramic spray coatings. In an alternate embodiment, forming the protective barrier can further comprise polishing (or smoothing) the thermal spray coating. For example, polishing the thermal spray coating can comprise the application of sand paper to the sprayed surfaces.

[0057] FIG. 11 presents a method of producing the deposition shield in the plasma processing system described in FIG. 1 according to another embodiment of the present invention. A flow diagram 500 begins in 510 with fabricating the deposition shield 14 (as described above). Fabricating the deposition shield can comprise at least one of machining, casting, polishing, forging, and grinding. For example, each of the elements described above can be machined according to specifications set forth on a mechanical drawing, using conventional techniques including a mill, a lathe, etc. The techniques for machining a component using, for example, a mill or a lathe, are well known to those skilled in the art of machining. The deposition shield can, for example, be fabricated from aluminum.

[0058] In 520, a protective barrier is formed on exposed surfaces of the deposition shield. A protective barrier comprising, for example Yttria, can be formed using (thermal) spray coating techniques that are well known to those skilled in the art of ceramic spray coatings. In an embodiment of the present invention, the exposed surfaces comprise the inner surface of the deposition shield, the upper end surface of the deposition shield, and the end lip surface of the lower end surface of the deposition shield. Alternately, the exposed surfaces can further comprise the first opening surface of the opening, and the mating surface excluding the fastening

surface of the opening in the deposition shield. Alternately, the exposed surfaces comprise all surfaces on the deposition shield. In an alternate embodiment, forming the protective barrier can further comprise polishing (or smoothing) the thermal spray coating. For example, polishing the thermal spray coating can comprise the application of sand paper to the sprayed surfaces.

[0059] The processes of forming a protective barrier 150 on the exposed surfaces 145, described with reference to FIGs. 9-11 can be modified to utilize a combination of machining and masking. In such a modified process, at least one exposed surface 145 is masked to prevent formation of the anodization layer thereon while other exposed surfaces 145 are anodized. The exposed surfaces 145 that are unmasked are then machined, and the exposed surfaces that were masked are unmasked. The protective barrier 150 can then be formed on all the exposed surfaces 145. As described above, additional surfaces that are not exposed surfaces may also be machined during the method (e.g., in order to provide a better mechanical or electrical contact than would be formed with the anodization layer thereon).

[0060] Although only certain exemplary embodiments of this invention have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention.

CLAIMS:

What is claimed is:

1. An improved deposition shield for surrounding a process space in a plasma processing system comprising:

a cylinder comprising an inner surface, an outer surface, an upper end surface, and a lower end surface, wherein said lower end surface further comprises an end lip surface; and

a protective barrier coupled to a plurality of exposed surfaces of said deposition shield, wherein said exposed surfaces comprise said inner surface, said upper end surface, and said end lip surface of said lower end surface.

2. The improved deposition shield as recited in claim 1, wherein said deposition shield further comprises a plurality of fastening receptors coupled to said upper end surface and said lower end surface of said deposition shield and configured to receive fastening devices in order to couple said deposition shield to said plasma processing system.

3. The improved deposition shield as recited in claim 2, wherein each of said plurality of fastening receptors comprises an entrant region, an entrant cavity, an exit through-hole, and an interior fastening surface.

4. The improved deposition shield as recited in claim 3, wherein said interior fastening surface of each of said plurality of fastening receptors comprises a first entrant surface, a first lip surface, a second entrant surface, a second lip surface, and an exit surface.

5. The improved deposition shield as recited in claim 1, wherein said deposition shield further comprises an opening in order to access said process space through said deposition shield.

6. The improved deposition shield as recited in claim 5, wherein said opening comprises a first opening surface, a second opening surface, and a mating surface.

7. The improved deposition shield as recited in claim 6, wherein said mating surface comprises at least one threaded hole and a fastening surface coupled thereto.

8. The improved deposition shield as recited in claim 1, further comprising a metal.

9. The improved deposition shield as recited in claim 8, wherein said metal comprises aluminum.

10. The improved deposition shield as recited in claim 1, wherein said protective barrier comprises a compound containing at least one of a III-column element and a Lanthanon element.

11. The improved deposition shield as recited in claim 10, wherein said III-column element comprises at least one of Yttrium, Scandium, and Lanthanum.

12. The improved deposition shield as recited in claim 10, wherein said Lanthanon element comprises at least one of Cerium, Dysprosium, and Europium.

13. The improved deposition shield as recited in claim 1, wherein said protective barrier comprises at least one of Y_2O_3, Sc_2O_3, Sc_2F_3, YF_3, La_2O_3, CeO_2, Eu_2O_3, and DyO_3.

14. The improved deposition shield as recited in claim 1, wherein said protective barrier comprises a minimum thickness and said minimum thickness is constant across at least one of said exposed surfaces.

15. The improved deposition shield as recited in claim 1, wherein said protective barrier comprises a variable thickness and said variable thickness ranging from 0.5 to 500 microns.

16. The improved deposition shield as recited in claim 6, wherein said plurality of exposed surfaces further comprise said first opening surface of said opening, and said mating surface of said opening in said deposition shield.

17. The improved deposition shield as recited in claim 7, wherein said plurality of exposed surfaces further comprise said first opening surface of said opening, and said mating surface excluding said fastening surface of said opening in said deposition shield.

18. The improved deposition shield as recited in claim 17, wherein said plurality of exposed surfaces further comprise said second opening surface of said opening.

19. The improved deposition shield as recited in claim 7, wherein said plurality of exposed surfaces further comprise said first opening surface of said opening, and said mating surface including said fastening surface of said opening in said deposition shield.

20. The improved deposition shield as recited in claim 19, wherein said plurality of exposed surfaces further comprise said second opening surface of said opening.

21. The improved deposition shield as recited in claim 19, wherein said outer surface comprises an anodization layer.

22. The improved deposition shield as recited in claim 19, wherein said second opening surface comprises an anodization layer.

23. The improved deposition shield as recited in claim 19, wherein said mating surface comprises a metallic surface.

24. The improved deposition shield as recited in claim 1, wherein said cylinder comprises a diameter greater than 200 mm.

25. A method of producing an improved deposition shield for surrounding a process space in a plasma processing system, said method comprising:

fabricating said deposition shield, said deposition shield comprising an inner surface, an outer surface, an upper end surface, and a lower end surface, wherein said lower end surface further comprises an end lip surface; and

forming a protective barrier on exposed surfaces, said exposed surfaces comprising said inner surface of said deposition shield, said upper end surface of said deposition shield, and said end lip surface of said lower end surface of said deposition shield.

26. The method as recited in claim 25, said method further comprising:

anodizing said deposition shield to form a surface anodization layer on said deposition shield; and

removing said surface anodization layer on said exposed surfaces.

27. The method as recited in claim 26, wherein said removing comprises at least one of machining, smoothing, polishing, and grinding.

28. The method as recited in claim 25, said method further comprising:

masking said exposed surfaces on said deposition shield to prevent formation of a surface anodization layer;

anodizing said deposition shield to form a surface anodization layer on the unmasked surfaces of said deposition shield; and

unmasking said exposed surfaces.

29. The method as recited in claim 25, wherein said fabricating comprises at least one of machining, coating, masking, unmasking, casting, polishing, forging, and grinding.

30. The method as recited in claim 25, wherein said forming comprises at least one of spraying, heating, and cooling

31. The method as recited in claim 25, said method further comprising smoothing said protective barrier.

32. The method as recited in claim 25, wherein said deposition shield further comprises a plurality of fastening receptors coupled to said upper end surface and said lower end surface of said deposition shield and configured to receive fastening devices in order to couple said deposition shield to said plasma processing system.

33. The method as recited in claim 32, wherein each of said plurality of fastening receptors comprises an entrant region, an entrant cavity, an exit through-hole, and an interior fastening surface.

34. The method as recited in claim 33, wherein said interior fastening surface of each of said plurality of fastening receptors comprises a first entrant surface, a first lip surface, a second entrant surface, a second lip surface, and an exit surface.

35. The method as recited in claim 34, further comprising machining said first entrant surface, said first lip surface, said second entrant surface, said second lip surface, and said exit surface.

36. The method as recited in claim 25, wherein said deposition shield further comprises an opening in order to access said process space through said deposition shield.

37. The method as recited in claim 36, wherein said opening comprises a first opening surface, a second opening surface, and a mating surface.

38. The method as recited in claim 37, wherein said mating surface comprises at least one threaded hole and a fastening surface coupled thereto.

39. The method as recited in claim 38, wherein said plurality of exposed surfaces further comprise said first opening surface of said opening and said fastening surface of said mating surface of said opening.

40. The method as recited in claim 38, wherein said plurality of exposed surfaces further comprises said first opening surface of said opening and said mating surface excluding said fastening surface of said opening.

41. The method as recited in claim 37, wherein said plurality of exposed surfaces further comprise said second opening surface of said opening.

42. The method as recited in claim 25, further comprising a metal.

43. The method as recited in claim 42, wherein said metal comprises aluminum.

44. The method as recited in claim 25, wherein said protective barrier comprises a compound containing at least one of a III-column element and a Lanthanon element.

45. The method as recited in claim 44, wherein said III-column element comprises at least one of Yttrium, Scandium, and Lanthanum.

46. The method as recited in claim 44, wherein said Lanthanon element comprises at least one of Cerium, Dysprosium, and Europium.

47. The method as recited in claim 25, wherein said protective barrier comprises at least one of Y_2O_3, Sc_2O_3, Sc_2F_3, YF_3, La_2O_3, CeO_2, Eu_2O_3, and DyO_3.

48. The improved deposition shield as recited in claim 25, wherein said protective barrier comprises a minimum thickness and said minimum thickness is constant across at least one of said exposed surfaces.

49. The improved deposition shield as recited in claim 25, wherein said protective barrier comprises a variable thickness and said variable thickness ranging from 0.5 to 500 microns.

50. A method of producing an improved deposition shield for surrounding a process space in a plasma processing system, said method comprising the steps:

fabricating said deposition shield, said deposition shield comprising an inner surface, an outer surface, an upper end surface, and a lower end surface, wherein said lower end surface further comprises an end lip surface;

anodizing said deposition shield to form a surface anodization layer on said deposition shield;

machining exposed surfaces on said deposition shield to remove said surface anodization layer, said exposed surfaces comprising said inner surface of said deposition shield, said upper end surface of said deposition shield, and said end lip surface of said lower end surface of said deposition shield; and

forming a protective barrier on the exposed surfaces.

51. The method as recited in claim 50, wherein said protective barrier comprises a compound containing at least one of a III-column element and a Lanthanon element.

52. The method as recited in claim 50, wherein said protective barrier comprises at least one of Y_2O_3, Sc_2O_3, Sc_2F_3, YF_3, La_2O_3, CeO_2, Eu_2O_3, and DyO_3.

53. A method of producing an improved deposition shield for surrounding a process space in a plasma processing system, said method comprising the steps:

fabricating said deposition shield, said deposition shield comprising an inner surface, an outer surface, an upper end surface, and a lower end surface, wherein said lower end surface further comprises an end lip surface;

masking exposed surfaces on said deposition shield to prevent formation of a surface anodization layer, said exposed surfaces comprising said inner surface of said deposition shield, said upper end surface of said deposition shield, and said end lip surface of said lower end surface of said deposition shield;

anodizing said deposition shield to form a surface anodization layer on said deposition shield; and

forming a protective barrier on the exposed surfaces.

54. The method as recited in claim 53, wherein said protective barrier comprises a compound containing at least one of a III-column element and a Lanthanon element.

55. The method as recited in claim 53, wherein said protective barrier comprises at least one of Y_2O_3, Sc_2O_3, Sc_2F_3, YF_3, La_2O_3, CeO_2, Eu_2O_3, and DyO_3.

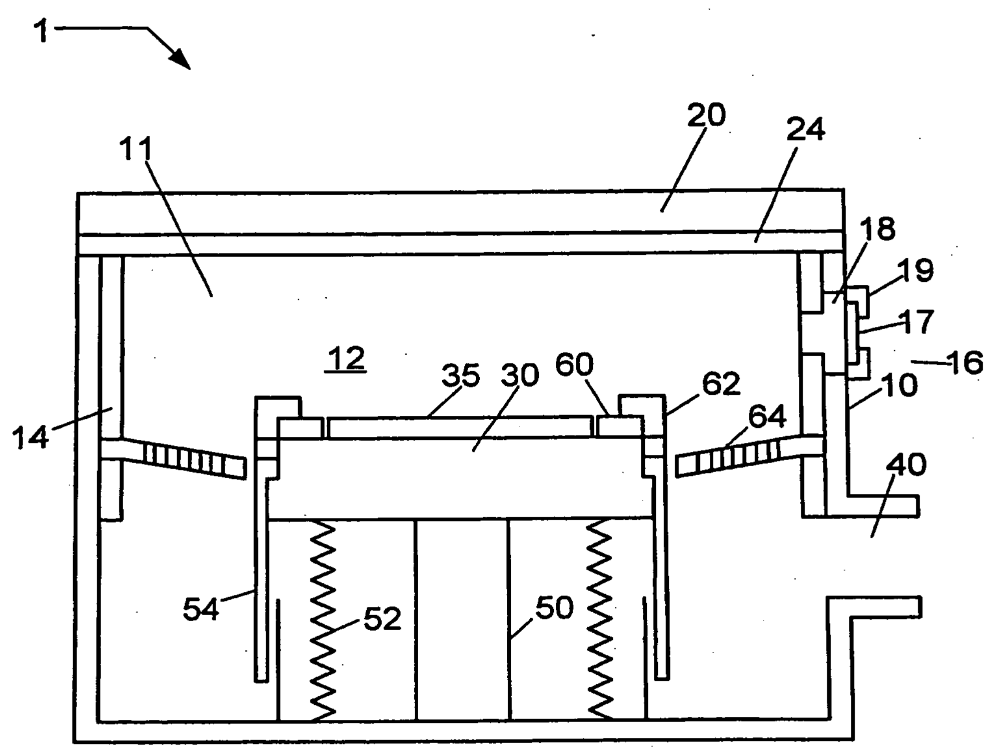

FIG. 1.

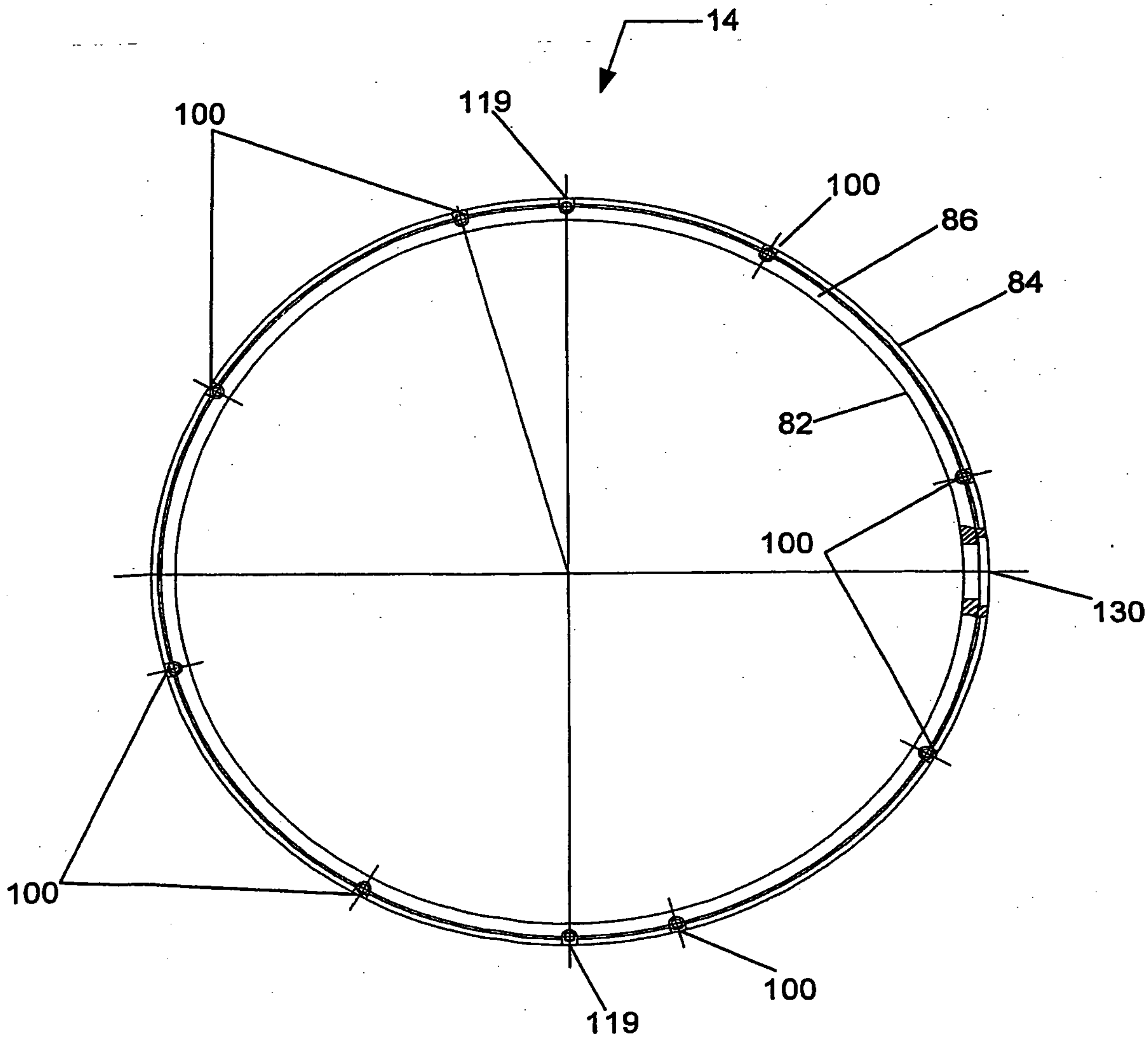

FIG. 2.

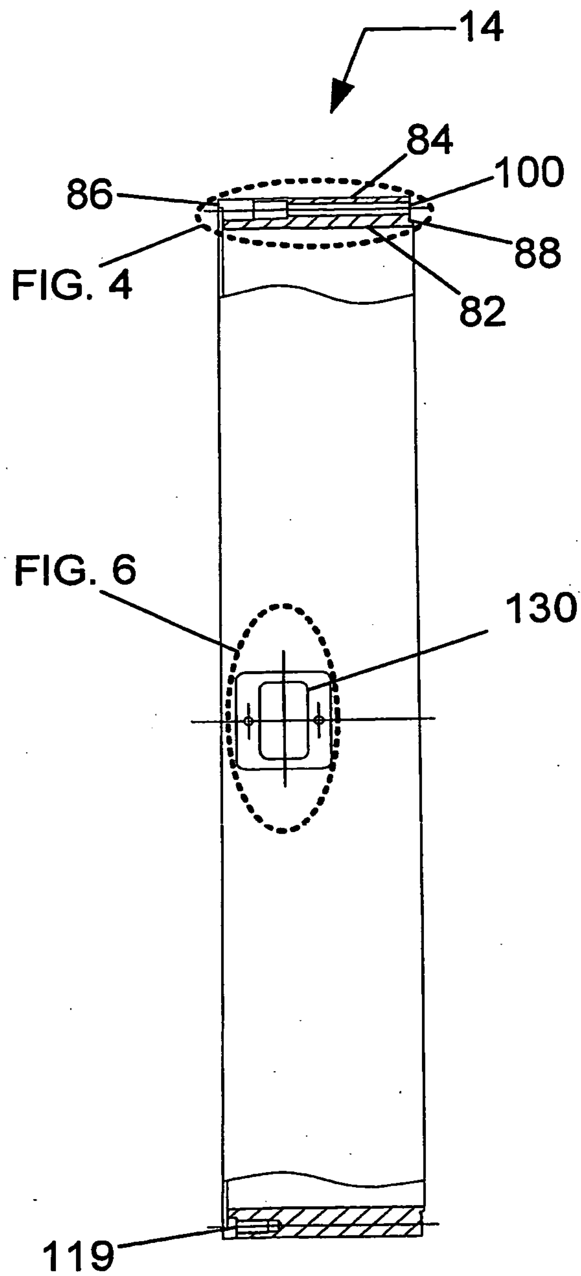

FIG. 3.

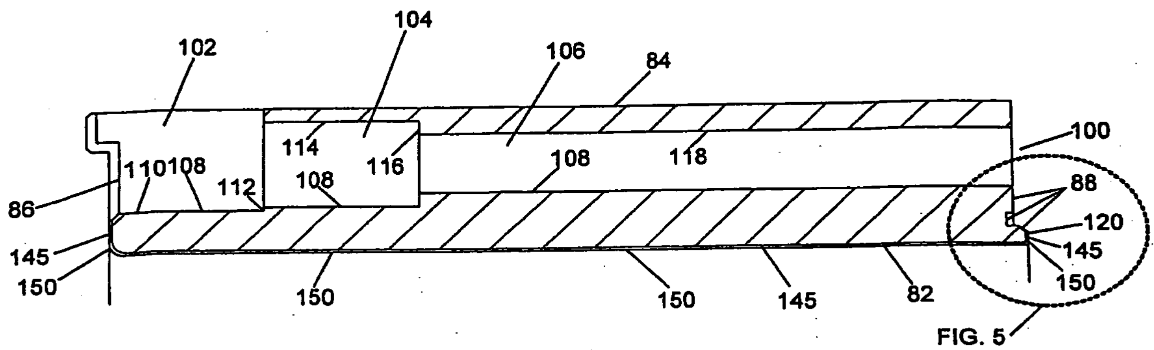
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FIG. 5

FIG. 4.

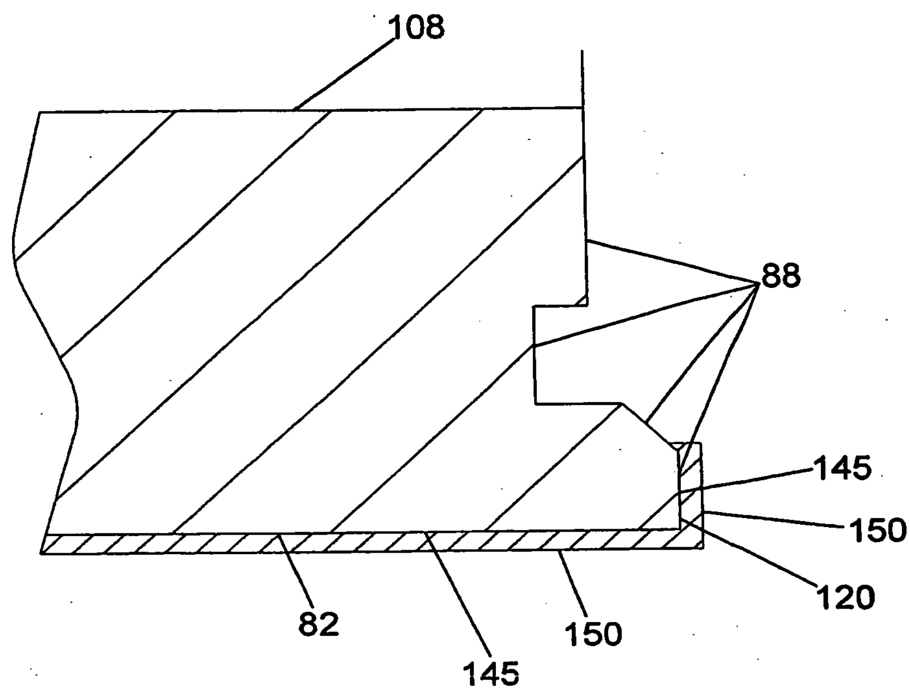

FIG. 5.

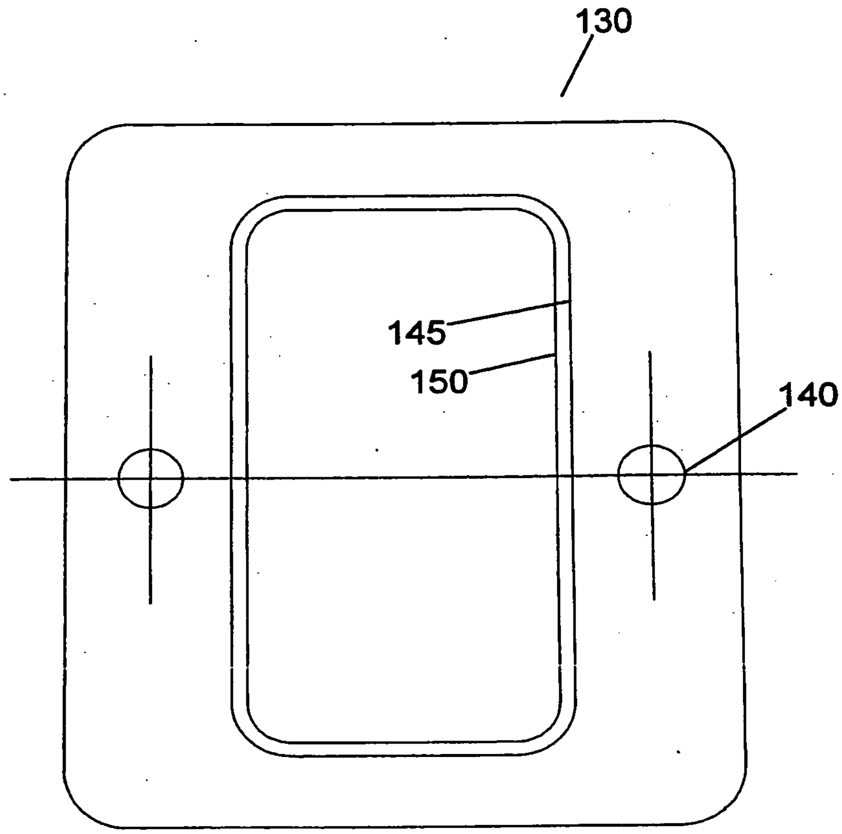

FIG. 6.

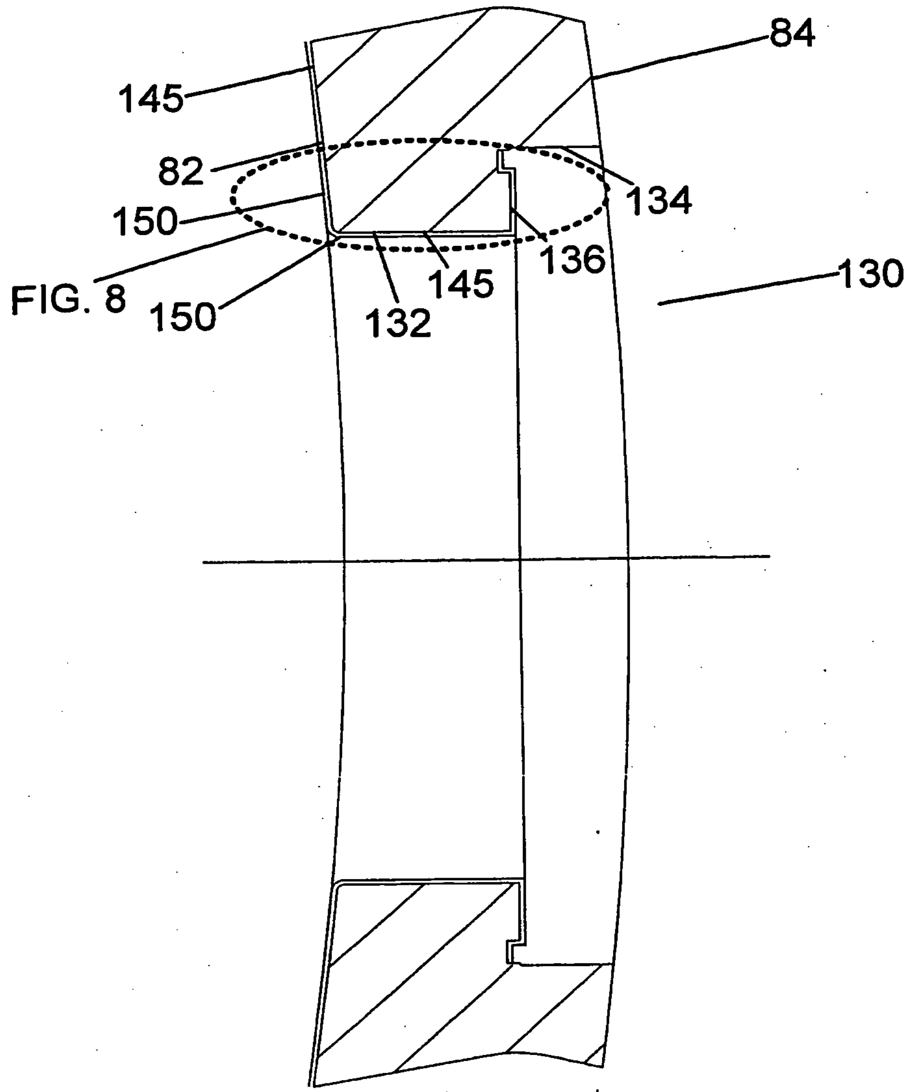

FIG. 7.

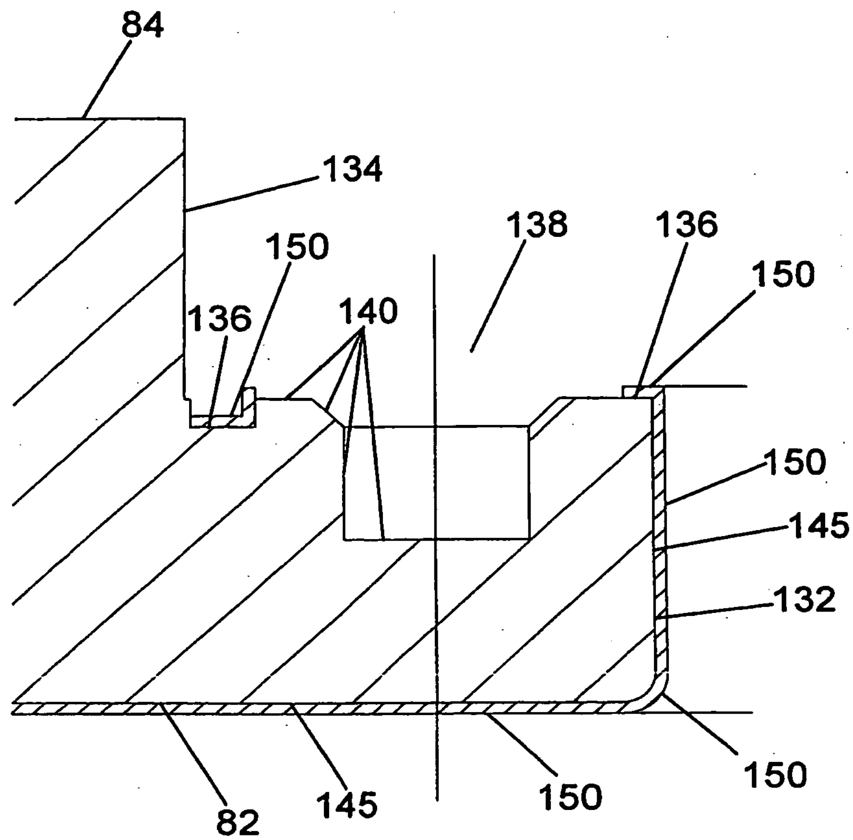

FIG. 8.

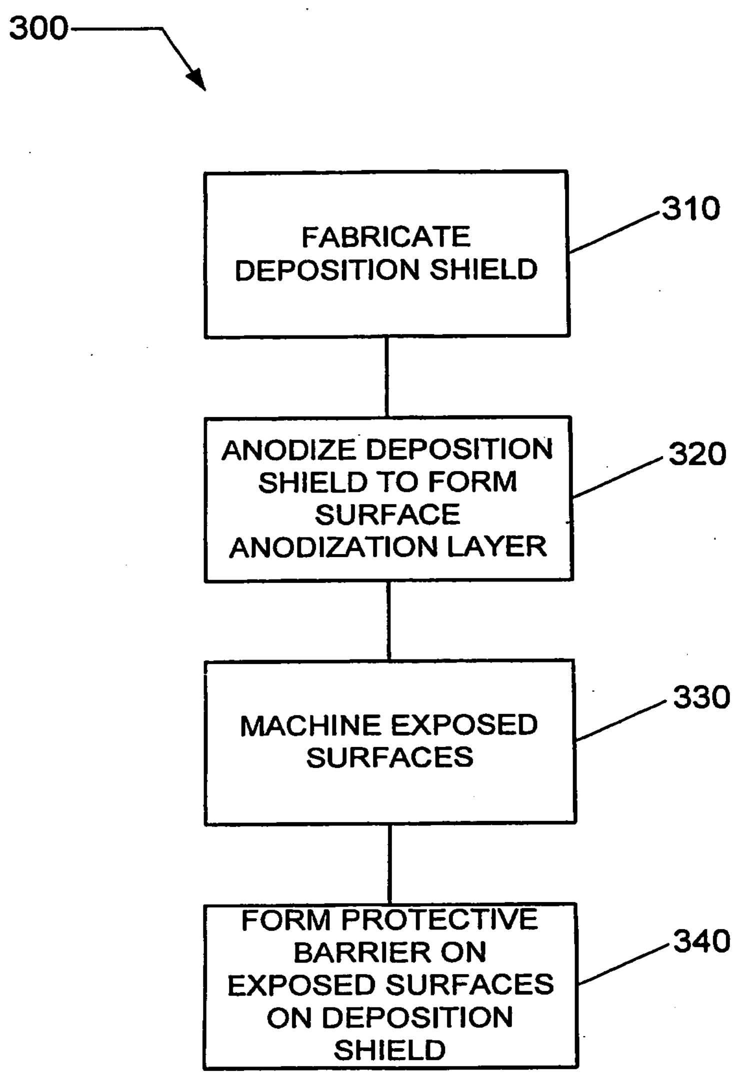
300
FABRICATE DEPOSITION SHIELD
310
ANODIZE DEPOSITION SHIELD TO FORM SURFACE ANODIZATION LAYER
320
MACHINE EXPOSED SURFACES
330
FORM PROTECTIVE BARRIER ON EXPOSED SURFACES ON DEPOSITION SHIELD
340

FIG. 9.

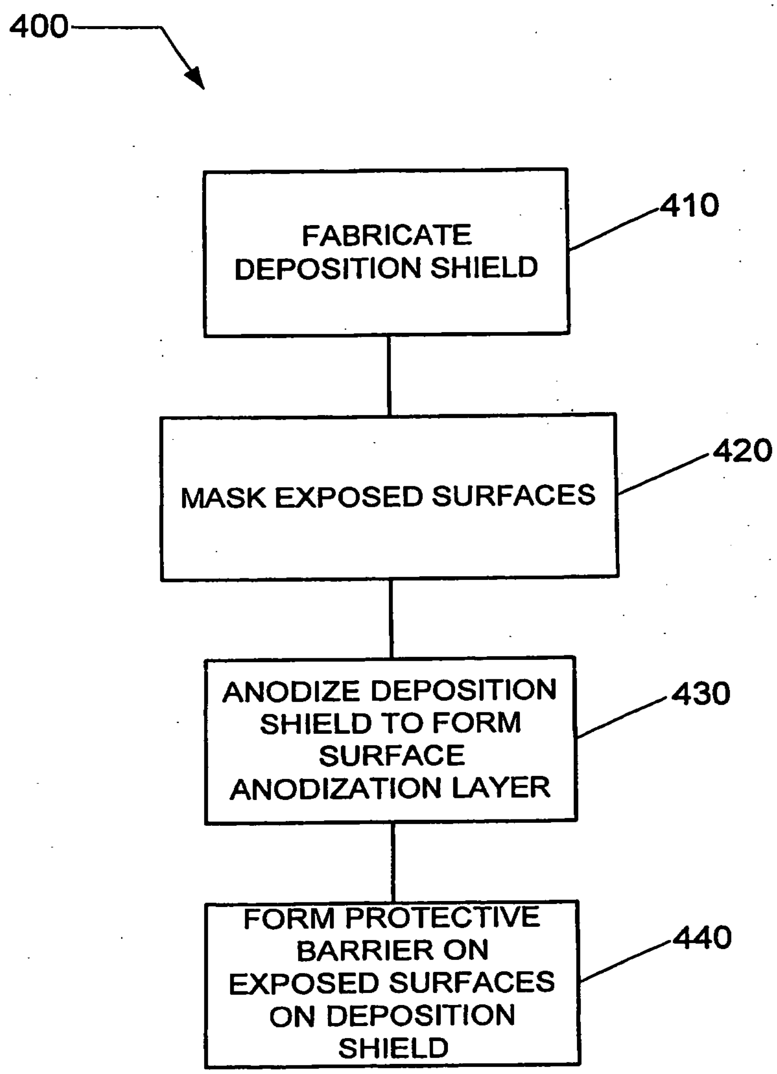
400
FABRICATE DEPOSITION SHIELD
410
MASK EXPOSED SURFACES
420
ANODIZE DEPOSITION SHIELD TO FORM SURFACE ANODIZATION LAYER
430
FORM PROTECTIVE BARRIER ON EXPOSED SURFACES ON DEPOSITION SHIELD
440

FIG. 10.

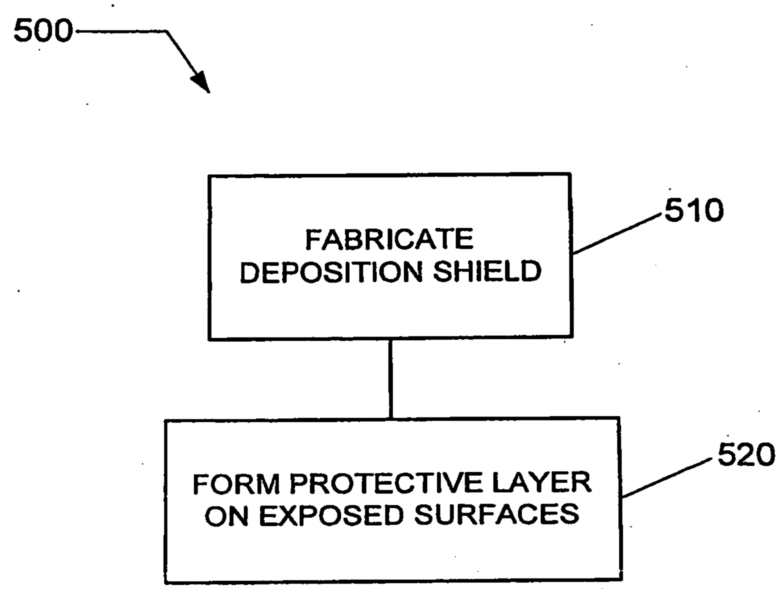
500
FABRICATE DEPOSITION SHIELD
510
FORM PROTECTIVE LAYER ON EXPOSED SURFACES
520

FIG. 11.